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Plants Diversity in Small Rubber Plantations at Segamat, Johor

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Abstract. Species richness in rubber plantations varies considerably with regards to production and management activities. This research was conducted to identify the diversity and richness of common plants in rubber plantations at Segamat, Johor. To answer the question of how rubber plantations owned by local smallholders affects the plant diversity, quadrat random method with 5 x 5 m plotting site was established in three different aged of rubber plantations at Segamat area which are Kg. Sedeng, Kg. Logah and Kg. Jawa. Each of the locations consisted of 10 sampling quadrats making a total of 30 quadrats. The results showed there are a total of 41 species belonging to 36 genera and 24 families in the 30 plots of the three plantations. The most dominant families were Rubiaceae, Euphorbiaceae and Asteraceae. The plants diversity were documented in rubber plantations at different location to record the number of species, the species evenness, similarity index, species richness, abundance parameter and important value index (IV_i). As for all three locations, the plants species were moderately diverse as the value of Shannon Diversity Index (H') moving closer to H_{max} but all the plotted area within three location showed higher evenness in species distribution. Based the result from density and frequency of abundance parameter, *Asystasia gangetica* species was the common species in all plantations. For the IV_i , there was only one species with absolute dominance (higher than 10%) which was *Asystasia gangetica* with value 13.62% for overall location at Segamat, Johor. In conclusion, the most common species in the smallholder rubber plantations at Segamat, Johor was *Asystasia gangetica*, *Bridelia tomentosa*, *Ageratum conyzoides*, *Caryota mitis* and *Melastoma malabathricum*. The rubber plantations adopting a minimal or natural management approach were dominated by common weed species and invasive plants. Despite the benefits of maintaining high species diversity for sustaining the gene pool, improving management practices is beneficial to improve yield and productivity.

1. Introduction

Rubber tree also known as *Hevea brasiliensis* (Wild. ex Adr. de Juss.) Muell. Arg is an important tropical tree crop that accounted for 29,118 volume ('000 tonnes) of the global natural and synthetic rubber production [1]. In Malaysia, rubber trees are widely cultivated due to the suitability of soil and climate, and mostly concentrated in the western coastal plains of Peninsular. The highest production of Malaysia's rubber is in the state of Johor, southern Malaysia. Here, rubber development possesses around 2 - 4 million acres of land or about 65% of the absolute cultivated area in Peninsular Malaysia.



Overall, Malaysia contributes 20% of the world's natural rubber production. Rubber is the main agriculture in this Segamat area which is an important source of income and wood industry production that contributes to the economic growth of the community and country. For instance, the tax of income generated from the export of rubber latex products is utilised by organisation such as Rubber Industry Smallholders Development Authority (RISDA) to provide grants and improve the livelihood of rubber smallholdings in Malaysia [2].

Despite the economic benefits, rapid expansion of monoculture rubber is decreasing the natural forest cover from around 70% in the 1970s to 50% in the 2000s [3] and affecting the biodiversity. Plants diversity is threatened by environmental change, contamination and pollution, habitat loss and overexploitation or overuse of natural resources [4]. In plants, diversity also allows different species to thrive in the many varied environments of the world. Plants have created adaptations for various soil types, daylight hours, techniques for pollination, temperature, elevation and competition with different plants. Previous study in Hainan, China by [5] reported that species of lianas, trees, shrubs and also herbaceous plants (include annual and perennial) can grow in rubber plantations. There are five dominant families with in excess of 10 species that could thrive in rubber plantation which are Asteraceae, Rubiaceae, Euphorbiaceae, Moraceae and Gramineae. The biggest family is *Rubiaceae* which has comprises 15 species, representing 8.2% of the all-out species [5]. Other plants include dominant weed species such as *Lasianthus reticulatus*, *Borreria alata*, *Phyllanthus amarus* and *Torenia peduncularis*, common grass species such as *Urochloa ramosa*, fern (*Lygodium* sp.), tree seedling species (*Symplocos cochinchinensis*) and herb (*Hemigraphis reptans*).

Diversity of plants varies with different location based on their dependent on the production activities [5][6][7]. For instance, in 2015, 95% of the rubber producers were smallholders [8] and lack of knowledge of herbicide and weed management could result in low yield, abandonment and exploration of new areas for cultivation. This can affect the plants species and influence species population. Eventhough there are many previous studies on plant diversity in rubber plantations, there is no other research conducted in rubber plantations at Segamat, Johor with regards to the plantations owned by local smallholders. Therefore, this study was undertaken to identify the diversity, richness, abundance and Importance Value Index of common plants in different aged rubber plantations at Segamat, Johor. Information on the type of dominant species in these plantations will benefit local smallholders in terms of employing correct management approach to enhance latex productivity of rubber tree [10].

2. Materials and Method

2.1 Study Area

The study was conducted in three rubber plantations at Segamat, Johor ($2^{\circ} 30' 53.28''$ N, $102^{\circ} 48' 56.88''$ E) mid June 2019 (Figure 1). Location 1 was Kg Sedeng ($2^{\circ} 29' 24.12''$ N, $102^{\circ} 49' 45.21''$ E) while location 2 was Kg Logah ($2^{\circ} 31' 35.43''$ N, $102^{\circ} 50' 59.08''$ E) and location 3 was Kg Jawa ($2^{\circ} 28' 39.18''$ N, $102^{\circ} 49' 37.85''$ E).

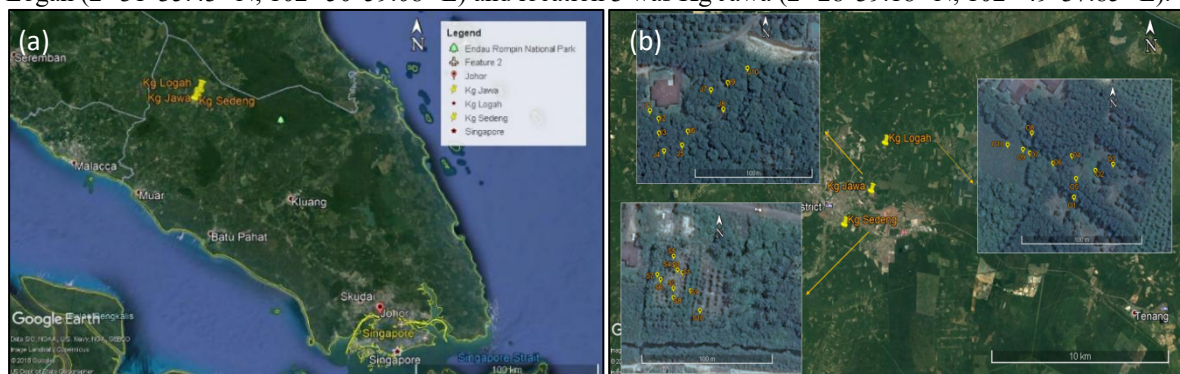


Figure 1. Location of (a) Johor state in southern peninsular Malaysia and, (b) the study areas and sampling points

2.2. *Experimental design*

Quadrat random method was used to identify species diversity. A 5m x 5m plotting site was established in the rubber plantations with three different site at Segamat area (Figure 1a). Each of the location consisted of 10 quadrant sampling making a total of 30 sampling quadrats (Figure 1b). Coordinates of the sampling points from all three locations were recorded using GPS positions device.

2.3 *Data collection*

2.3.1 *Sample collection*

All plants within the plot were collected, pre-identified, counted and recorded for the evaluation of species diversity and their dominance status. The samples collection was done regardless of common species or rare species in all sites. The plants were chosen based on their matured characteristics such as mature stem, leaves and reproductive structures. The plants were cut using secateurs, and all the specimens were tagged with name tag to avoid mixing up the samples. The plants were tagged based on their locality, date, and plot. Then, all the specimens were placed inside the plastic bag.

2.3.2 *Specimen preservation*

The specimen from the fieldwork was preserved to sustain their characteristics prior to identification. All specimens were removed from plastic bag. The specimens were spread out between the folds of newspapers to avoid overlapping of parts. Then, the specimen was transferred into a plastic bag that contains 70% ethanol for the preservation process. Before drying, all samples that were preserved with ethanol-soaked newspapers were stacked in new newspaper folds. All samples were covered by a new newspaper to avoid damage and folding for pressing and drying process. The newspaper must be dry to avoid plants disease such as fungi. Plant samples were trimmed to fit into a one page of a newspaper. After that, all the sample was tied with a strap and was press down equally on all sides to ensure even distribution of the force applied [11]. Then, the sample that have been covered by newspaper was pressed by using plant press (wooden). Finally, all the sample was brought back to Universiti Malaysia Kelantan. The specimen was left to dry in the oven for seven days duration at 45° C - 50°C.

2.3.3 *Herbarium preparation and specimen identification*

The sample of plant species was collected and preserved as herbarium specimens for further identification [12]. All the identification process was conducted in Laboratory at UMK Jeli Campus. The dried specimens were mounted on herbarium sheets. Mounting includes securing the pressed plant material and label to an A3 sheet paper. Hence, to secure the specimen on A3 sheet, the specimen was spotted glue with PVA. The specimen was sewn with needle and thread, then securing knots with linen tape to make it neat. The function of mounting is to enable specimen to be taken care of effectively and easily, protect all the specimens against harm or damage and ensures that the label and plant stay together. After that, all herbarium sample was stored in the storage box to ensure the plants were safe properly. The silica gel was added to absorb moisture from the air and help kept the seeds and plants dry for a long time.

Species identification of unknown species was done by referring experts, books and reliable resources from the internet. Identification of plants specimen using “Picture This” application and botanical book [13]. The “Picture This” application works by identifying plants via user-submitted photos. To identify plant by using this application, the user needs to upload a photo of plant species to verify. Visually clean, this application gives a basic identification about the plant that has been identified as well as care information. At the same, the book of “Flora of Peninsular Malaysia” was used to gain information about plants morphology characteristics. The specimen was identified according to their family, genus and species. The identified specimens were verified by plant ID expert, Dr Radhiah Binti Zakaria from Faculty of Public Health, Muhammadiyah University of Aceh.

2.4 General observation

In this study, after surveying the plants species based on the plotting area, the general observation of plants outside the plotting area were also identified to add additional information about list of plants species in rubber plantations at Segamat, Johor. General observation was carried out at the three different locations by collects other plants surrounding the established 5x5 m plot. All the species from general observation was observed and recorded but the data was not included in diversity analysis.

2.5 Data analysis

2.5.1 Diversity index

Diversity indices consist of Shannon Index, Shannon Evenness Index and Similarity index. Shannon Diversity Index is used to characterize species diversity in a community.

- i. Shannon index [14],

$$H = - \sum_{i=1}^s (p_i \ln p_i)$$

Where:

H' = Shannon's Diversity Index

S = total number of species in the community

p_i = species individual proportion

- ii. Shannon's equitability (Evenness Index) [15].

Evenness index refers to the species in number close to environment. Evenness also used to measure degree in abundance of species [16].

$$E_H = \frac{H}{H_{max}} = \frac{H'}{\ln S}$$

Where:

E_H = Equitability (evenness) Index

H' = Shannon's diversity index

S = total number of species in the community

- iii. Sorensen Similarity Index [17]:

$$\text{Sorensen's coefficient (Cs)} = \frac{2a}{2a + b + c}$$

Where,

a = the Total Number of Species Present in Location 1 and 2

b = the Number of Species Present in Location 1

c = the Number of Species Present in Location 2

2.5.2 Margalef index

Margalef Index also known as Richness Index was used to calculate species richness by using formula cited by [18].

$$\text{Margalef's index} = \frac{S - 1}{\ln N}$$

Where:

S = total number of species

N = total number of individuals in the samples
ln = natural logarithm.

2.5.3 Abundance parameter

Density of plants was the number of individuals per number of total number of individuals incurred from the area studied while the frequency was the number of occurrences of the species within the 10 plotted area. The vegetation data were analysed for % frequency (F) and density (D). Abundance parameter functions as to calculate frequency and density as equation below:

i. density

$$\text{Density} = \frac{\text{number of individual of species in sampling unit}}{\text{total number of sampling unit studies}} = \frac{ni}{A}$$

Where,

ni = number of individuals of a species in sampling unit
A = total number of sampling unit studied

ii. frequency

Frequency equation was used for the proportion of sampling unit's likes the quadrat or field that contains the species.

$$\text{Frequency} = \frac{\text{total of quadrant in which species occur}}{\text{total number of quadrant}} \times 100 = \frac{ji}{k}$$

Where,

ji = number of quadrant in which species occur
k = total number of quadrant studied

2.5.4 Importance Value Index

The important value index (IVI) was a degree to measure dominance of a species in one particular area. The importance value was used to calculate the sum from (ii) the relative frequency and (iii) the relative density.

i) Importance value index = $\frac{\text{relative density} + \text{relative frequency}}{2}$

ii) The relative density = $\frac{\text{density of species}}{\text{total density of all species}} \times 100$

iii) The relative frequency = $\frac{\text{frequency of species}}{\text{total frequency of all species}} \times 100$

3.0 Result and Discussion

3.1 Floristic diversity

An analysis of floristic diversity was made at three different plantations of rubber plantations at Segamat, Johor with the total area was 4.5 acres. A total of 2367 individuals of angiosperms and gymnosperms was recorded belonging to 24 families, 36 genera and 41 species based on 30 plotted area and general observation (Appendix).

There were nine dominant families which were Arecaceae, Asteraceae, Euphorbiaceae, Lauraceae, Melastomataceae, Myrtaceae, Phyllanthaceae, Rubiaceae and Tiliaceae. Indeed, the presence of the Rubiaceae generally represented by species of wood is a character common to all tropical rainforests as noted [19].

There were 17 common species in all the three locations sites at the rubber plantations. Common species meant plants, tree or vegetation that always occur, found, or prevalent in that particular area based on their overall presence in the environment. Common species also designations used in ecology to describe the population status of a species.

However, there were not much publications and research regarding plants diversity in rubber plantations in Peninsular Malaysia especially in Johor, therefore the data collected in this study were compared to the study conducted at China. There were a few studies on species diversity in a rubber plantation in South China. Based on the study by [5], a total of 183 plant species belonging to 155 genera and 69 families in the 1hm² plot was reported. There were five dominant families (with more than 10 species), that were Rubiaceae, Euphorbiaceae, Gramineae, Asteraceae, and Moraceae. The largest family was Rubiaceae, which has 15 species, accounting for 8.2% of the total species. From that result, it can be concluded that the common plant species in rubber plantations was from Rubiaceae, Euphorbiaceae and Asteraceae families.

3.2 Diversity indices in rubber plantations at Segamat, Johor

3.2.1 Shannon index

As for the overall plotted areas from Kg. Sedeng, Kg. Logah and Kg. Jawa in rubber plantations at Segamat, Johor, the value of Shannon-Diversity Index (H') was 2.84 followed by H_{\max} 3.58. The diversity for the overall studied was moderately diverse because the value of H' nearly approaching H_{\max} .

Based on the Table 1, the value of Shannon-Diversity Index (H') for different plantations species distribution of plants diversity at Kg. Sedeng was 2.73 and the H_{\max} value was 3.43. The result tabulated indicated that Kg. Sedeng had relatively high diversity of species among the monocot and dicot species as the H' value was approaching the H_{\max} value. However, Kg. Jawa was the least diverse in species while Kg. Logah was moderately diverse in species which the H' was 2.62 and H_{\max} was 3.30. For Kg. Jawa, the value was least diverse compared to Kg. Jawa which H' value was 2.51 and H_{\max} was 3.22. The main factors that leads different number of species in the three location were the different treatment and management by the owner of each plantations.

Table 1: Shannon diversity index (H') of plants species recorded at three locations of rubber plantations at Segamat, Johor

Location	Shannon Index (H')	H_{\max}
Overall	2.84	3.58
Kg. Sedeng	2.73	3.43
Kg. Logah	2.62	3.30
Kg. Jawa	2.51	3.22

The plantation at Kg. Sedeng was the most diverse and also the evenest plantation of all the three study sites followed by Kg. Logah. This might be due to relatively undisturbed plantations of less management practice like weed management using herbicide. In Kg. Sedeng and Kg. Jawa, the treatment for the plantations were low compared to Kg. Jawa. Thus, this make Kg. Sedeng and Kg. Logah highly diverse in species. Secondly, it might also be due to the abandonment of farming activities by an owner and the successional changes in the vegetation as lands had been left to fallow for a very long time in both areas [20]. The Kg. Jawa plantations was the least diverse of all the sites and was probably due to the good management plan. This had resulted many plant species less appear in this area. Table 2 shows details information of area, age, treatment, type of herbicides and management practice that used by owner to conserve their rubber plantations. All rubber tree at the three locations of study sites was matured at age 6 years.

Table 2. The area, age, treatment, type of herbicides and management practice that used by owner of three plantations at Segamat, Johor.

Plantations	Kg. Sedeng	Kg. Logah	Kg. Jawa
Area	1 acre	1 acre	2.5 acres
Age	8 years	7 years	25 years
Tapped years	2 years	1 year	19 years
Treatment	Once in a months	Two times in a months	Two or three times in a week depends to weather condition
Type of herbicide used	Organic	Organic and chemical	Organic, natural and chemical
Management practice	Low	Moderate	High

According to [21], it is widely believed that artificial forests are subjected to production activities and always have lower species richness than natural forests. However, in this study, the results showed that after the plantations had good natural management, species richness of rubber plantation was not so much lower than that of other tropical rainforests in Malaysia as compared with other studies in Peninsular Malaysia.

According to [22], the Shannon diversity index has strong values for species with recoveries of the same importance, and it takes low values, when some species have strong recoveries. Several causes could explain variations in the degree of biodiversity between the plots of the studied area were age of rubber tree, management and treatment from an owner, rainfall trends, anthropogenic action, land- use change, and so forth.

3.2.2 Shannon's Equitability (Evenness Index)

A value for evenness approaching 0 reflects large differences in abundance of species, whereas an evenness of one means all species are equally abundant. The evenness index E_H was calculated for each plot.

Table 3. Shannon's equitability (Evenness Index, E_H) of plants species recorded at three locations of rubber plantations at Segamat, Johor

Location	Shannon's equitability (E_H)
Overall	0.79
Kg. Sedeng	0.79
Kg. Logah	0.79
Kg. Jawa	0.78

From the table 3 above, the highest value of E_H for species distribution at the rubber plantations of Segamat, Johor recorded was at Kg. Sedeng and Kg. Logah which 0.79. This can be indicated that both plantations had the highest evenness communities between plants species and the species were well distributed. The E_H value for Kg. Jawa was 0.78, which was also relatively high. The overall E_H value for all plantations was 0.79. Thus, it can be said that the value for all three plantations showed that the species distribution of plants were highly even among the species. This can be concluded that all the species distributed in three locations had a large differences in abundance (H_{max}) of species as value for evenness approaching 0.

3.2.3 Sorensen Similarity Index

Table 4 represents a table showing similarities between the three different study sites. All the study area of plantations were low and had the similarity within the range 0.36-0.49. Kg. Sedeng and Kg. Logah had the highest family similarity index which were 0.43 while Kg. Logah-Kg. Jawa were 0.39 and Kg. Jawa-Kg. Sedeng were 0.36.

Table 4. Sorenson Similarity Index of plants species recorded at three locations of rubber plantations at Segamat, Johor

Study area	Family level	Genus level	Species level
Kg. Sedeng – Kg. Logah	0.43	0.48	0.44
Kg. Logah – Kg. Jawa	0.39	0.49	0.43
Kg. Jawa – Kg. Sedeng	0.36	0.49	0.42

For the genus level, Kg. Logah – Kg. Jawa and Kg. Jawa – Kg. Sedeng had the same degree of similarity which were 0.49. All plantations almost had similar value which in range 0.48 and 0.49. The value of genus that existed were not approaching 1 that can be concluded as low similarity.

Sorenson similarity index in terms of species between Kg. Sedeng-Kg. Logah were the highest. This shows that between that plantations have many plants species that are similar. The factor that contributed to similar species were because of geographical factor, moisture and direct sunlight. Kg. Jawa-Kg. Sedeng was less similar to all the other sites. This was due the gap between each species was far that causes the vegetation had different moisture, nutrient and sunlight. Overall, this can be indicated that the Sorenson similarity index in the three rubber plantations at Segamat, Johor was less similarity.

3.3 Margalef Index / Richness Index of Plants Sampling

Table 5 shows the extension for the richness index was to measure the species richness in the area of 4.1 rubber plantations/acres. Overall, the value of richness index was 4.50. The total number of species was 36 and total number of individual's species in the quadrat was 2367. This can be said that the richness of species was relatively high in Kg. Sedeng, Kg. Logah and Kg. Jawa. Kg. Sedeng had the highest richness index which were 4.33 compared to Kg. Logah and Kg. Jawa. The cause of higher richness index due to the highest number of individuals found in 1 acres which was 1015 of individual's species. Kg. Jawa has the lowest value of richness index which were 3.74 as the area of plantations were less dense with vegetation compared to Kg. Logah and Kg. Sedeng.

Table 5: The Margalef's Index in three locations of rubber plantations at Segamat, Johor

Location	Total number of species (S)	Total number of individuals in the sample (N)	Margalef's Index/ Richness Index
Overall	36	2367	4.50
Kg. Sedeng	31	1015	4.33
Kg. Logah	25	743	3.93
Kg. Jawa	25	609	3.74

3.4 Abundance parameter

3.4.1 Density and frequency of plants sampling

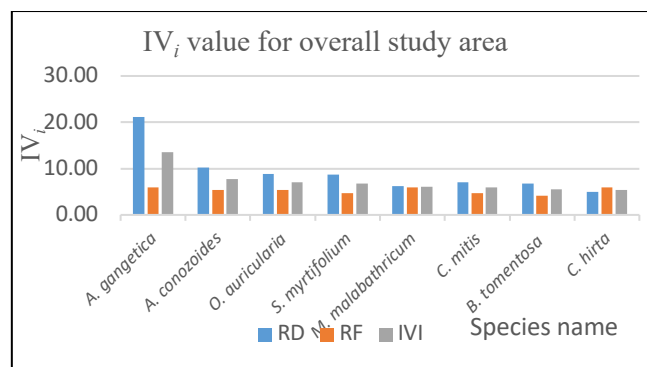
Frequency was a measure of the uniformity of the distribution of a species; thus a low frequency indicates that a species was either irregularly distributed or rare in a particular stand or forest. The frequency and density class distribution of plants species in different study sites are depicted in the Table 6. Overall, the total density and frequency was 78.9 and 15% respectively. *Asystasia gangetica* had the highest density and frequency value of plants species which was 16.40 and 97% for three rubber plantations at Segamat, Johor due to abundant number of individuals and frequency present in 30 quadrat.

Table 6. Summation of density and frequency by total species occur in studied areas in rubber plantations at Segamat, Johor

Location	Density	Frequency (%)
Overall	78.9	15
Kg. Sedeng	101.5	16.8
Kg. Logah	74.3	15
Kg. Jawa	60.9	12.5

3.4.2 Importance Value Index of Plants Sampling

As indicated by [23], the species that had the value of (IV_i) more than 10% was considered as absolute dominance. IV_i was used to rank each species and the plant species with the highest importance value in the stand was considered the dominant species. IV_i was the important ecological parameter for observing the status of species in an area. As shown in Figure 2, there were only one species with absolute dominance which were *Asystasia gangetica* with the value higher than 10% respectively for overall studied area of rubber plantations at Segamat, Johor for the overall. According to the [24], *A.gangetica* has caused major problems in the ecosystems of the Pacific Islands. It is potentially highly invasive. The risk of introduction of rhizome material as a contaminant of soil and compost remains high in those countries where the plant is well established. *A.gangetica* is a rapidly fast growing perennial plant that can easily grow in free, impeded and seasonally waterlogged soil drainage. Additionally, this species can form a dense ground cover, presumably competing with other native species [25].

**Figure 2:** The Importance Value Index (IV_i) for overall study

On the basis of Importance value, *Asystasia gangetica* was the most abundant species of the area followed by *Ageratum conozoides* and third associated species was *Oldenlandia auricularia* which all this species recorded as the highest number of diversity in rubber plantations.

3.5 General observation

In this study, after surveying the diversity of plants based on the plotting area, the general observation of plants species outside the plotting area was also identified to support checklist of data collection. This general observation also can add additional information about list of composition of diversity of plants in rubber plantations at Segamat, Johor. From the result, the total of seven species belonging to six families and seven genus were recorded (Table 7).

Table 7. The species composition of plants based on general observation carried out around the rubber plantation

Family	Genus	Species
Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
Arecaceae	<i>Cocos</i>	<i>nucifera</i>
Asteraceae	<i>Elephantopus</i>	<i>mollis</i>
Lauraceae	<i>Litsea</i>	<i>grandis</i>
	<i>Litsea</i>	<i>lanceolata</i>
Meliaceae	<i>Langsium</i>	<i>domesticum</i>
Theaceae	<i>Eurya</i>	<i>acuminata</i>

4.0 Conclusion

Segamat, Johor has varying plants diversity in different locations which were Kg. Sedeng, Kg. Logah and Kg. Jawa. The total of 30 quadrats random method was successfully executed during the sampling for the three rubber plantations. Based on the results, the overall plants diversity composition that was identified was 41 species in 36 genera and 24 families. From the result recorded throughout the research conducted at Segamat, Johor, the composition and diversity of plants recorded was relatively moderate. The Shannon-Diversity Index and Shannon Evenness Index calculated are $H' = 2.84$ and $E_H = 0.79$ for the overall common species that available in rubber plantations. Kg. Sedeng consists of highest Shannon diversity index which were 2.73 and $E_H = 0.79$ while Kg. Logah moderately diverse which the value of $H' = 2.62$ and $E_H = 0.79$ followed by Kg. Jawa that less diverse, $H' = 2.51$ and $E_H = 0.78$. Meanwhile, species abundance and Importance Value Index (IVI) of common plants that grows in rubber plantations area at Segamat, Johor determined. *Asystasia gangetica* species was totally dominance for overall plot at rubber plantations at Segamat, Johor with IVI value were 13.62%. Those with low IVI values, they are less dominance. Thus, it was concluded that the most common species in rubber plantations were *Asystasia gangetica*, *Bridelia tomentosa*, *Ageratum conozoides*, *Caryota mitis* and *Melastoma malabathricum*. In conclusion, rubber plantation at Segamat, Johor were moderately diverse in species recorded. The finding shows that the age and management of plantations of rubber tree could be the factors that can affect the dominance of common weed species and invasive plants in rubber plantations at Segamat, Johor. However, more is needed with regards to the relationship between the dominant species of common weeds and invasive plants with latex productivity from rubber plantations owned by local smallholders.

Appendix I Overall family, genus, species and number of individuals of plants sampling from three rubber plantations at Segamat, Johor

No	Family	Genus	Botanical Name	Number of Individuals
1	Acanthaceae	<i>Asystasia</i>	<i>Asystasia gangetica</i>	492
2	Anacardiaceae	<i>Mangifera</i>	<i>Mangifera indica</i>	1
3	Arecaceae	<i>Cocos</i>	<i>Cocos nucifera</i>	**
4		<i>Pinanga</i>	<i>Pinanga</i> sp.	15
5		<i>Caryota</i>	<i>Caryota mitis</i>	91
6	Asteraceae	<i>Ageratum</i>	<i>Ageratum conozoides</i>	161
7		<i>Ageratum</i>	<i>Ageratum houstonianum</i>	15
8		<i>Conyza</i>	<i>Conyza sumatrensis</i>	70
9		<i>Crassocephalum</i>	<i>Crassocephalum crepidoides</i>	48
10		<i>Elephantopus</i>	<i>Elephantopus tomentosus</i>	74
11		<i>Elephantopus</i>	<i>Elephantopus mollis</i>	9
12	Dilleniaceae	<i>Tetracera</i>	<i>Tetracera indica</i>	77
13	Elaeocarpaceae	<i>Elaeocarpus</i>	<i>Elaeocarpus</i> sp.	9
14	Euphorbiaceae	<i>Macaranga</i>	<i>Macaranga bancana</i>	37
15		<i>Macaranga</i>	<i>Macaranga tanarius</i>	15

16		<i>Mallotus</i>	<i>Mallotus paniculatus</i>	16
17		<i>Elateriospermum</i>	<i>Elateriospermum tapos</i>	53
18	Fabaceae	<i>Pithecellobium</i>	<i>Pithecellobium jiringa</i>	31
19	Lamiaceae	<i>Vitex</i>	<i>Vitex pinnata</i>	26
20	Lauraceae	<i>Cinnamomun</i>	<i>Cinnamomun iners</i>	44
21		<i>Litsea</i>	<i>Litsea grandis</i>	**
22		<i>Litsea</i>	<i>Litsea lanceolata</i>	**
23	Leeaceae	<i>Leea</i>	<i>Leea indica</i>	50
24	Malvaceae	<i>Urena</i>	<i>Urena lobata</i>	63
25	Melastomataceae	<i>Clidemia</i>	<i>Clidemia hirta</i>	66
26		<i>Melastoma</i>	<i>Melastoma malabathricum</i>	88
27	Meliaceae	<i>Langsium</i>	<i>Langsium domesticum</i>	**
28	Myrtaceae	<i>Psidium</i>	<i>guajava</i>	3
29		<i>Synzygium</i>	<i>Synzygium zeylanicum</i>	2
30		<i>Syzygium</i>	<i>Syzygium myrtifolium</i>	144
31	Phyllanthaceae	<i>Bridelia</i>	<i>Bridelia tomentosa</i>	289
32		<i>Bridelia</i>	<i>Bridelia stipularis</i>	3
33	Piperaceae	<i>Peperomia</i>	<i>Peperomia pellucida</i>	16
34	Poaceae	<i>Setaria</i>	<i>Setaria palmifolia</i>	1
35	Primulaceae	<i>Ardisia</i>	<i>Ardisia elliptica</i>	10
36	Rubiaceae	<i>Morinda</i>	<i>Morinda elliptica</i>	29
37		<i>Oldenlandia</i>	<i>Oldenlandia auricularia</i>	275
38	Rutaceae	<i>Murraya</i>	<i>Murraya koenigii</i>	26
39	Sapindaceae	<i>Leucaena</i>	<i>Leucaena leucocephala</i>	2
40	Theaceae	<i>Eurya</i>	<i>Eurya acuminata</i>	**
41	Tiliaceae	<i>Grewia</i>	<i>Grewia laevigata</i>	16
TOTAL	24	36	41	2367

**Number of individuals from the plot surrounding were not counted but just noted

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